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AIR-COOLED ARC WELDING IMPLEMENT

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AIR-COOLED ARC WELDING IMPLEMENT

BACKGROUND OF THE INVENTION

The present invention relates generally to the field of arc welding, and more particularly to the field of air-cooled arc welding torches.

Arc welding is a welding process in which an electric current is used to produce localized melting in a work piece. There are many different types of arc welding processes. One example of an arc welding process is TIG (Tungsten Inert Gas) welding (also known as gas tungsten arc welding, GTAW, or HELIARC). TIG welding is a type of arc welding process in which an electric arc is maintained between a welding implement, such as a hand-held welding torch, and a metal work piece. Typically, the welding implement includes a cylindrical electrode coupled to a torch head. The arc is produced by electricity that flows between the electrode and the work piece. Typically, the electrode is comprised of tungsten. The electricity for the arc welding process is provided by a power source coupled to the torch head of the welding implement by a power cable.

The electricity flowing through the torch head may produce a substantial amount of heat. In addition, the electricity flowing through the electrode and the work piece may produce heat that is transferred to the torch head. The heat introduced into the torch head may damage the components of the torch. In addition, the heat may make the torch

difficult to hold. The amount of heat produced is a function of the current flowing through the torch. The torches may be air-cooled at low current levels. However, the ability of air-cooling to sufficiently cool the torch decreases as the amount of current flowing through the torch increases. Consequently, the amount of current at which the torch is operated may be limited by the temperature increase in the torch caused by the current flowing through the torch. Therefore, liquid-cooled welding torches have been developed to remove a greater amount of the heat from within the torch head, thereby enabling the torch to be operated at higher current levels. However, liquid cooling the torch increases the cost and complexity of the torch and the welding system used to operate the torch. For example, a liquid–cooled torch requires a liquid-cooling unit to produce a flow of cooling liquid and to remove the heat from the liquid.

Therefore, a need exists for a technique to increase the ability of an air-cooled TIG welding torch to remove heat. More specifically, a need exists for a technique to enable an air-cooled welding torch to remove a greater amount of heat so that the torch may be operated at greater current levels.

BRIEF DESCRIPTION OF THE DRAWINGS

The foregoing and other advantages and features of the invention will become apparent upon reading the following detailed description and upon reference to the drawings in which:

Figure 1 is an elevational view of a TIG welding system, in accordance with an exemplary embodiment of the present invention;

Figure 2 is an exploded view of the TIG welding torch assembly of Figure 1;

Figure 3 is a cross-sectional view of the torch of Figure 2; and

Figure 4 is an elevational view of the internal portions of the torch of Figure 2.

DETAILED DESCRIPTION OF SPECIFIC EMBODIMENTS

Referring generally to Figure 1, a welding system 10 is illustrated. The TIG welding system 10 comprises a welding power supply 12 and a welding torch assembly 14. The power supply 12 may be a constant current AC, DC, a combination AC/DC source, or some other type of power supply. In the illustrated embodiment, the system 10 also comprises a gas cylinder 16 that is coupled by a hose 18 to the welding power supply 12. The gas cylinder 16 supplies gas 20 to the welding power supply 12, which in turn supplies the gas 20 to the welding torch assembly14 via a second gas hose 22. A power cable 24 is also coupled from the welding power supply 12 to the welding torch assembly 14. The system 10 also comprises a return cable 26 and clamp 28 to electrically couple a work piece 30 to the power supply 12.

The welding torch assembly 14 is adapted to couple electricity from the power supply 12 to the work piece 30 and to direct a flow of gas toward the point of contact with the work piece 30. The welding torch assembly 14 is adapted to receive an electrode 32. The welding torch assembly 14 has a torch 34 that is adapted to hold the electrode 32. The welding torch assembly 14 also comprises a nozzle 36 to produce a conical flow of gas 20 directed towards the work piece 30 and a back cap 38 to seal the opposite end of the torch 34 and to receive the electrode 32. A handle 40 is coupled to the torch 34 to enable a user to direct movement of the welding torch assembly 14. When the electrode 32 comes into close proximity to the work piece 30, an arc is produced between the electrode 32 and the work piece 30, completing an electric circuit between the power supply 12 and the work piece 30. An electric current 41 flows from the power supply 12 through the welding torch assembly 14 to the electrode 32, work piece 30, and back to the power supply 12. The electric current 41 flowing through the work piece 30 causes localized melting. The gas 20 forms a shield around the weld puddle.

Referring generally to Figure 2, the welding torch assembly 14 comprises a plurality of components. In the illustrated embodiment, the torch assembly 14 comprises a collet 44 and a collet body 46 used to secure the electrode 32 to the torch 34. The collet body 46 receives the electrode 32 therethrough. The collet 44 and collet body 46 are urged together by threading the back cap 38 into the torch 34, causing the collet body 46 to compress against the electrode 32. In addition, an insert 48 and a cup gasket 50 also are secured to the torch 34.

The gas hose 22 and the power cable 24 are connected to the connector 42 of the torch 34 by a nipple 52, a nut 54, and a current nipple 56. The gas hose 22 and the power cable 24 are connected to the current nipple 56. The nut 54 secures the current nipple 56 to the connector 42. Gas 20 and electricity 41 flow from the current nipple 56 through the nipple 52 to the torch 34. The gas hose 22 is secured to the power supply 12 by a ferrule 58, a nut 60, and a nipple 62. The power cable 24 is connected to the power supply 12 by a fitting 64 housed within a first insulating boot 66 and a second insulating boot 68. In the present embodiment, the power cable 24, nipple 52, current nipple 56, and fitting 64 are air-cooled and adapted to conduct 300 Amps to the torch 34.

Referring generally to Figure 3, the torch 34 comprises a torch head 70 that is coupled by a speed channel 72 to the connector 42. The speed channel 72 is a tube comprised of a conductive metal to enable electricity to flow from the connector 42 to the torch head 70. Preferably, the torch head 70 and speed channel 72 are comprised of copper. Electricity flowing through the torch head 70 and the speed channel 72 produces heat. In the illustrated embodiment, some of the heat within the torch 34 is transferred to the air. In addition, some heat is transferred by conduction from the torch head 70 through the speed channel 72 and connector 42 to the power cable 22. The heat in the power cable 22 is subsequently transferred by convection to the air. In addition, some of the heat within the torch 34 is transferred by convection to the gas 20 flowing through the torch head 70 and speed channel 72. In the illustrated embodiment, a heat dam 74 is provided to absorb additional heat from the torch head 70 and couple the heat to the speed

channel 72. Preferably, the heat dam 74 comprises a copper tube disposed around the speed channel 72.

Torch 34 also comprises a thermal storage member 76 that is adapted to take advantage of the duty cycle of the system 10 to cool the torch 34. The thermal storage member 76 is adapted to cool the torch head 70 during operation of the torch 34 by storing heat transferred from the torch head 70 via the speed channel 72. The thermal storage member 76 then releases the heat to the speed channel 72 when power to the torch head 70 is removed. The heat is transferred from the speed channel 72 to the air via the power cable 24 and the torch head 70.

Those skilled in the art will recognize that a number of factors are relevant to the design of the thermal storage member 76. For example, the specific heat capacity (c) of the thermal storage member 76 and the mass (m) of the thermal storage member 76 are relevant in defining the heat storage characteristics of the thermal storage member 76. For a given material, the larger the mass of the material, the greater the amount of heat that can be stored within the material. However, the torch will be heavier with a greater mass of material. In addition, the thermal conductivity (k) of the thermal storage member 76 is relevant in defining how quickly heat will be conducted to and from the thermal storage member 76. Therefore, all of these factors, and others, may be balanced when selecting the size and composition of the thermal storage member 76. In the illustrated embodiment, the thermal storage member 76 comprises aluminum.

An insulator 78 is disposed between the thermal storage member 76 and the speed channel 72 to electrically isolate the thermal storage member 76 from the speed channel 72. Thus, no electrical current flows through the thermal storage member 76 to generate heat. In addition, the insulator 78 positions the thermal storage member 76 axially along the speed channel 72. Preferably, the insulator 78 comprises teflon.

In the illustrated embodiment, the torch 34 is covered by an insulating material 80. Preferably, the insulating material is silicone rubber. In addition, the insulating covering 80 comprises a plurality of ridges 82. The ridges 82 are adapted to produce friction to secure the handle 40 to the torch 34 when the handle 40 is disposed over the torch 34.

In accordance with European (CE) welding temperature standards, the current rating of a welding torch is defined by the temperature increase at the handle and cable at the rated current with the torch operating at a 60 % duty cycle (i.e., subjected to a current flow 60 % of a standard unit of time). The increase in temperature must be less than 30 K at the handle and less that 40 K at the cable for a welding torch to be rated at a given current rating. A prototype of the welding torch described above was tested with the power supply supplying 300 Amps at a 60 % duty cycle. The top of the handle was measured to increase by 27 °F on the top of the handle and to increase by 21.5 °F on the bottom of the handle. This corresponds to an increase in temperature in Kelvin of approximately 15.2 K and 12.2 K, respectively.

The above-described embodiment of an air-cooled welding torch provides a technique for increasing the ability of an air-cooled welding torch to remove heat. In addition, the above-described embodiment of an air-cooled welding torch is operable to provide sufficient cooling to enable the torch to conduct a 300 Amp current within temperature limits.

While the invention may be susceptible to various modifications and alternative forms, specific embodiments have been shown by way of example in the drawings and have been described in detail herein. However, it should be understood that the invention is not intended to be limited to the particular forms disclosed. Rather, the invention is to cover all modifications, equivalents, and alternatives falling within the spirit and scope of the invention as defined by the following appended claims.